SAFE MANIPULATION

FOREWORD

This book is dedicated to the locksmiths and safemen of America in order to improve their technique and knowledge in opening and servicing safes.

We will familiarize you with how manipulation is possible and mainly how it is accomplished, step by step, with every make safe lock, including the new manipulation resistant locks.

We must remind you that manipulation is not learned overnight, but requires diligent study and practice and after becoming proficient, one or two safe openings will more than pay for the cost of this book.

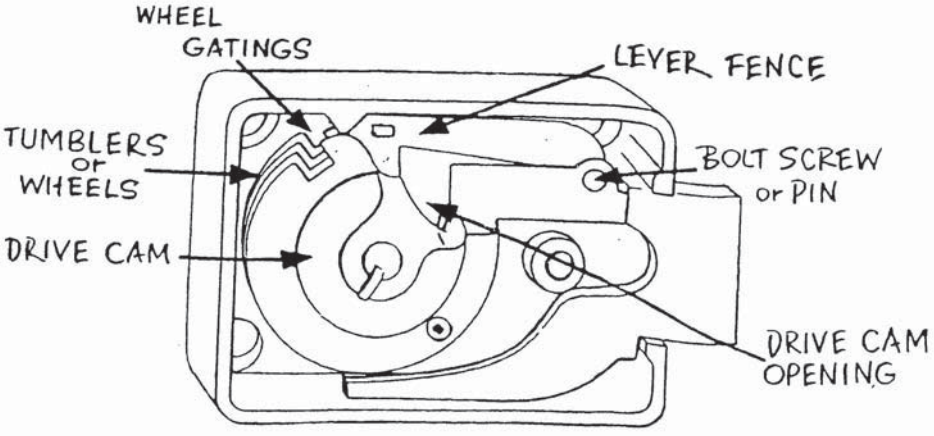
It is extremely important that the information contained in this book be faithfully guarded so as not to fall into the hands of undesirables.

We also suggest after you have become proficient in the art of manipulation to destroy this book completely, so as to protect yourself and our craft.

DEFINITION:

MANIPULATION—is herein defined as the art of opening combination locks without prior knowledge of present combination, without the use of force or tools, without damage to any part and without leaving evidence of entry.

NOMENCLATURE OF PARTS



Why Manipulation Is Possible

1. Differences in widths of gating in wheel and drive-cam.

2. Differences in wheel post diameter.

3. Eccentricity of wheels.

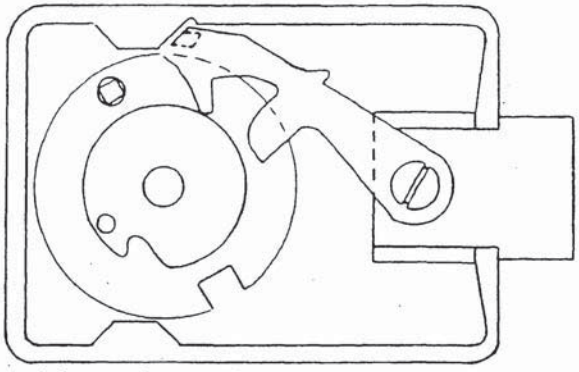
4. Inaccuracy in manufacturing—
   In machine made parts there must be a certain degree of tolerances or clearances. (Example) The inside diameter of the wheels must be approximately .005 larger than the wheel post in order for the wheels to rotate freely on the post.

5. Differences in distances between nose of levers and fences.

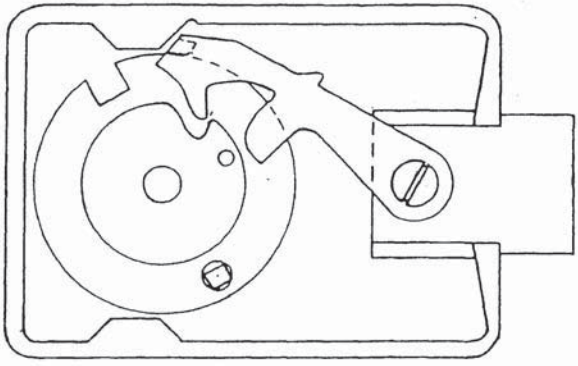
6. Differences in diameter of drive-cam.

7. Squareness in wheel gatings and fences.

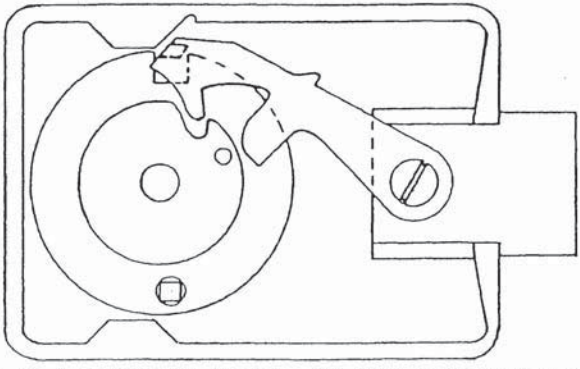
8. A. *Lever Fence Type Locks.*
   The lever is secured to the bolt by a screw, or pin, and in some locks is equipped with a lever spring, so that the lock can be mounted in different positions (Vertical up, Vertical down, Right or Left hand.) In order for the lever to work freely on the bolt screw, or pin, the inside diameter of the hole in the lever must be considerably larger than the outside diameter of the bolt screw, or pin. You can see by the illustrations on page 7 what actually happens and how this tolerance between lever and bolt creates a different position of the fence—



Note position of fence and nose of lever as it rides on drive cam.



Note fence resting on wheels with nose of lever in drive cam opening.



Note: With No. 3 wheel-gating lined up with fence and lever nose in drive-cam opening, fence rests on No. 1 and No. 2 wheels, allowing fence to tilt into gating of No. 3 wheel and nose of lever to drop further into drive-cam opening.

How Manipulation Is Possible

1. To arrange wheels by dialing to indicate their position in relation to the fence.

2. How to determine relationship: a. Sight. b. Sound. c. Feel.

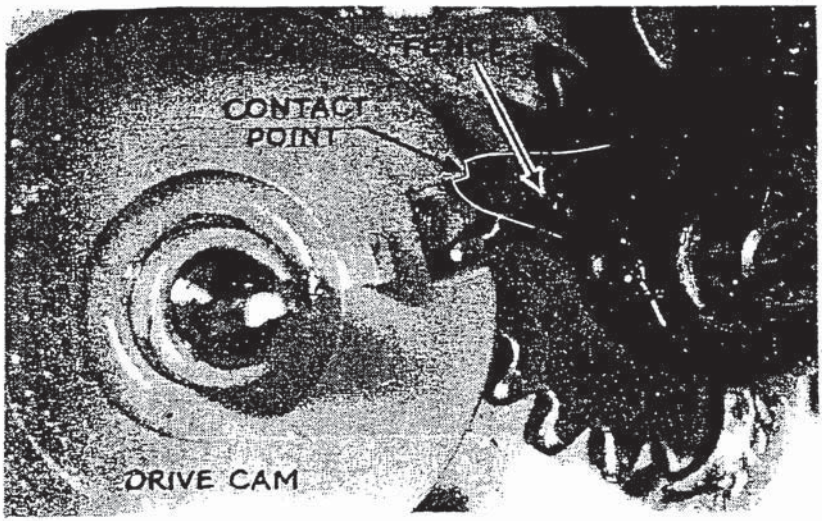
3. Use of electronic or mechanical devices are not necessary, but in some cases may be beneficial.

At this point you should mount a 3-wheel lever fence type lock on a block of wood or similar mount, so that you might follow us through in our step by step explanation of manipulation. We decided to use the lever type lock so that it might be easier to explain one type lock and later explain the different technique used in other type locks. The principle is the same in all types of locks.

It will be to your advantage after having the satisfaction of opening the lever fence type lock, to mount four or five locks of different manufacturers and types to use for practice. Someone, after explanation, can set up the combination for you.

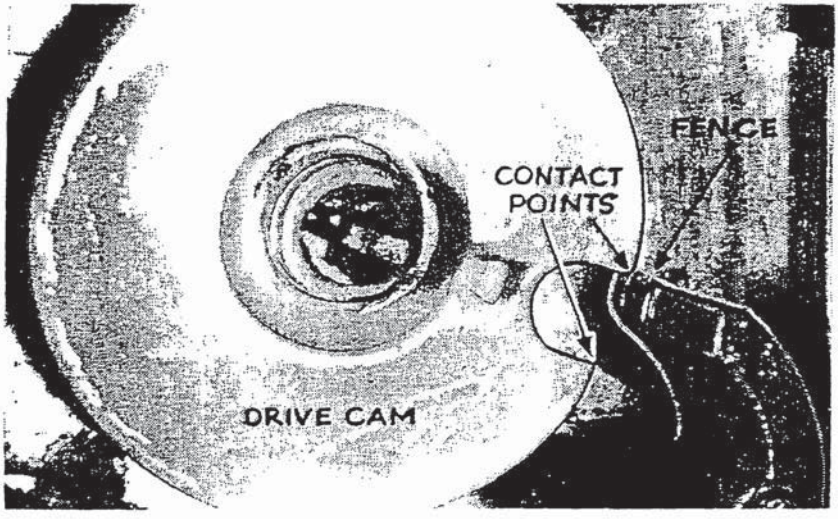
TYPES OF LOCKS

1. ROTARY FENCE GEAR DRIVEN



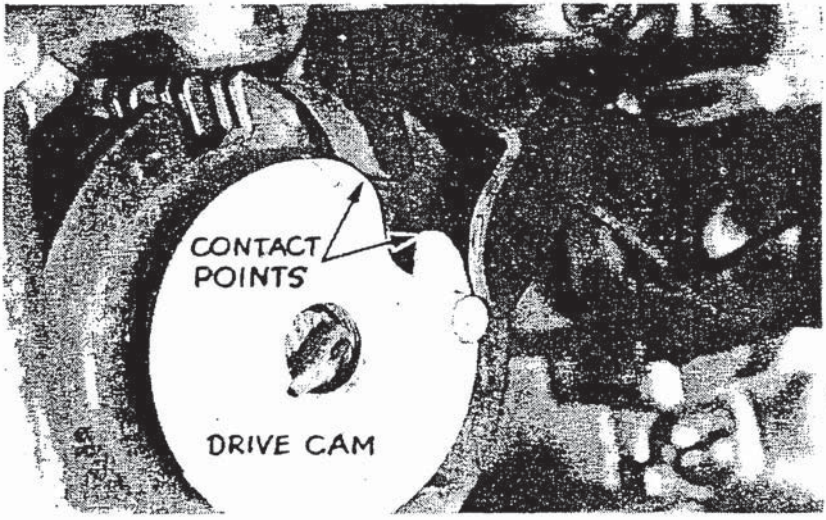
Dial must be rotated to left on this type lock in order for you to take readings and get indications as the fence only touches drive-cam when turning left.

2. ROTARY FENCE, SPRING ACTUATED



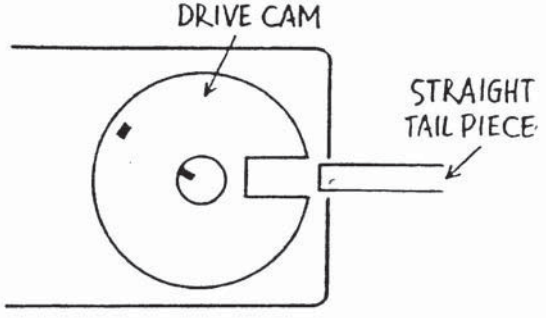
This type lock has 2 contact points and either one can be used to obtain indications and take readings. Generally the sloping side of the fence gives better indications rather than the sharp side.

3. LEVER FENCE



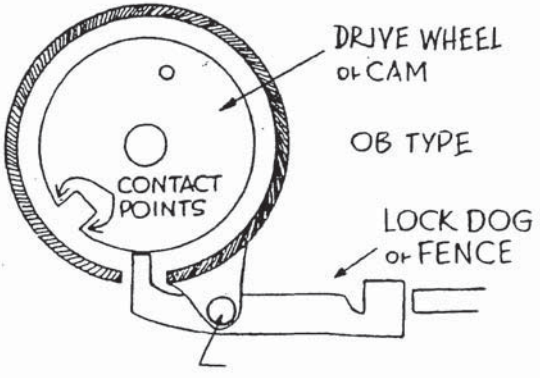
This type lock has 2 contact points and either one can be used to obtain indications and take readings. Generally the sloping side of drive cam gives better indications rather than the sharp side of drive cam.

4. STRAIGHT TAIL PIECE



This type lock differs from other types, in that indications and readings are taken from handle.

5 BOTTOM DROP



This type lock has 2 contact points and either one usually gives the same indications and readings.

Manipulation

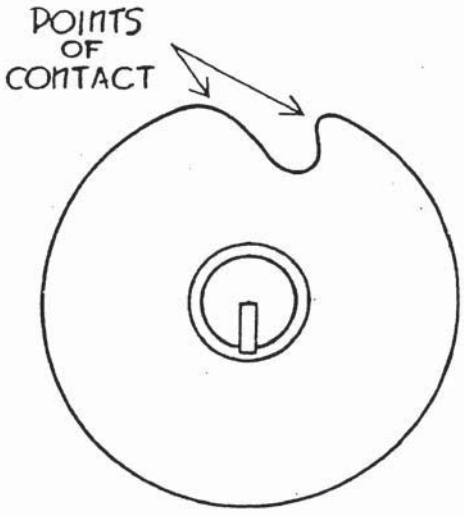
STEP 1. *Determine number of tumblers or wheels in lock.*

In order to learn manipulation well, the first step is to determine how many tumblers or wheels in the lock, this is also very helpful on your service calls in determining stuck tumbler flys, tumblers sticking together, loose back plate screws, etc.

Turn dial right or clockwise 6 times stopping on 60, now turn left or counter-clockwise slowly to 50 then rapidly continue left past 60, listening and feeling as you pick up the wheel closest to drive cam (the count is now 1 wheel), continue turning left to 50 then rapidly past 60, listening and feeling as you pick up next wheel, (the count is now 2 wheels). Continue turning left to 50, then rapidly past 60, listening and feeling, as you pick up next wheel (the count is now 3 wheels), continue turning left to 50, then rapidly past 60, listening and feeling as you pick up next wheel (the count is now 4 wheels). At this point, if you could not hear or feel the pickup of a wheel the lock has only 3 wheels. Continue turning left to 50 then rapidly past 60, listening and feeling as you pick up the next wheel (the count is now 5 wheels).

STEP 2. *Determining the contact points*

This is most important because you will get indications of readings from the contact points.



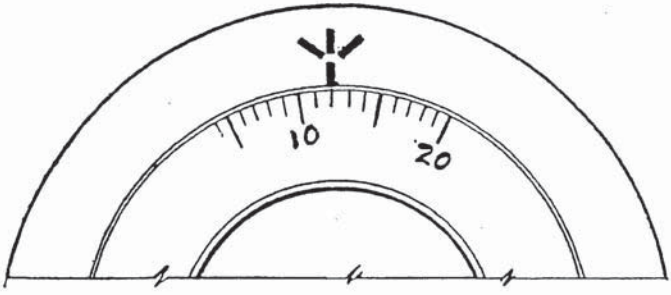
1. Rotate dial 4 times to Right stopping at 60 (5 times on 4 wheel lock), turn left and attempt to feel and hear when the lever touches each side of the gateway of the drive-cam.

Do this by oscillating over an area of approximately 10 numbers at a time until you have determined the 2 contact points or each side of the drive-cam opening or drop-in point.

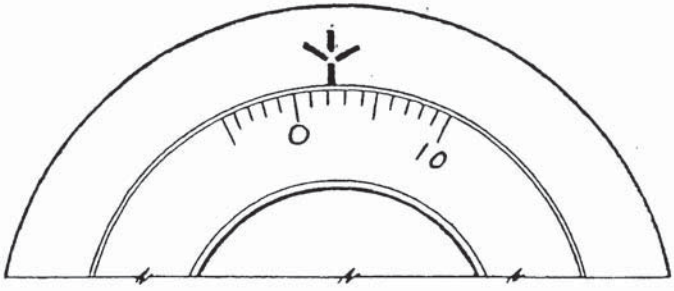
After finding the 2 contact points, lightly grasp dial between thumb and forefinger and rotate dial lightly between 2 contact points and note carefully exact point on *dial*, lever contacts drive-cam on either side.

(SEE DIAL ILLUSTRATIONS PAGES 16 and 17)

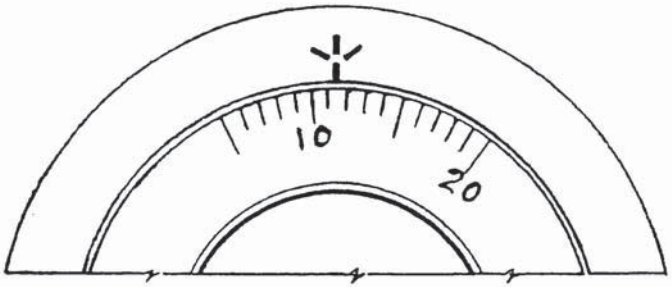
DIAL ILLUSTRATIONS



Note: Using sloping side on drive cam, contact point reads 12 on dial.



Note: Using sharp side of drive cam, contact point reads 2¼ on dial.



Note: Using sloping side of drive cam and with No. 3 wheel gating lined up with fence reading improves or drops to 11½ on dial as the nose of the lever drops further into drive cam opening.

A. *Lever Fence Type Locks.* (SEE PAGE 6)

B. *Rotary Fence Type Locks, Spring Actuated.*

The fence is mounted on a post secured to the lock case. In order for the fence to work freely on the post, it also has to have a considerable amount of tolerance. This type lock will react in the same way as the lever fence type lock as to taking readings.

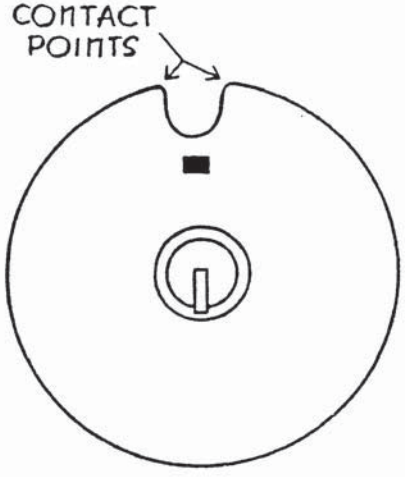
(SEE PAGE 10)

C. *Rotary Fence Type Lock, Gear Driven.*

The fence in this lock works in conjunction with a fence gear which in turn is actuated by the drive cam gear. This type lock differs from the above in that the fence only touches the drive cam when rotating dial to left, therefore has only one contact point.

(SEE PAGE 9)

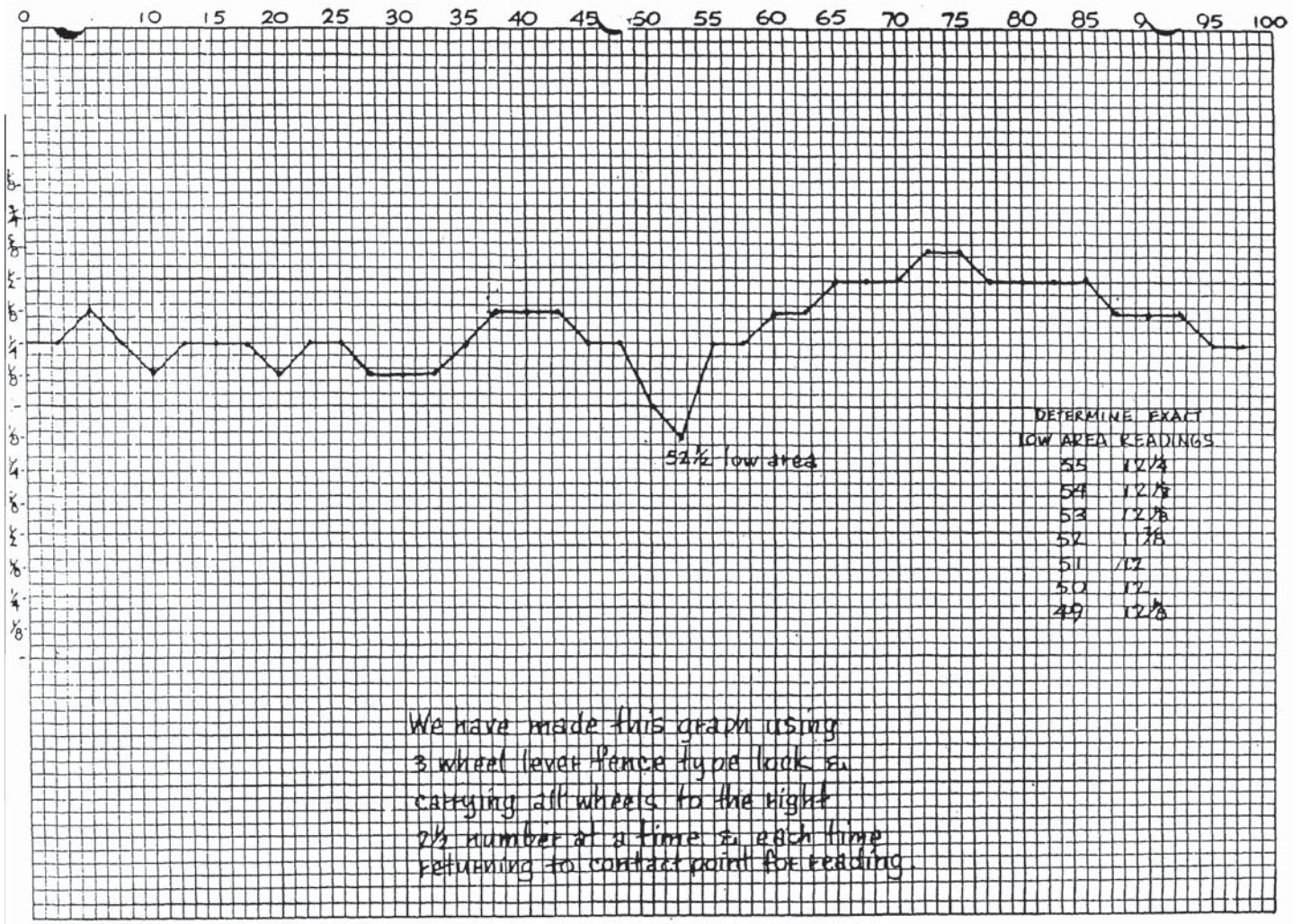
2. Determine which one of the 2 contact points you are going to use to get your indications or readings on the dial. In some cases it is better to use the sloping side of the drive-cam opening because it will give a better indication on the dial when a wheel gating lines up with the fence. In other cases it makes no difference which contact point you use as the drive-cam opening has the same contour on each side. Illustration:



STEP 3. *Finding low area of Wheel Pack or Tumbler Gates.*

"EXPLANATION"—Since the purpose of manipulation is to get the fence to drop further and further into the wheel pack, we must discover the low spots on the wheels on the assumption that the lowest spot may be either a wheel gating or a dip in the edge of the wheels that will permit the fence to contact the edge of the next lowest wheel or tumbler. In other words, we keep working toward the lowest spot at all times.

NOTE—Our Graph Illustration made from 3 wheel lever type lock. Prepare to make graph of your readings—Graph paper can be obtained from any large stationery store.


0 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100
52½ low area
DETERMINE EXACT
LOW AREA READINGS
55 12¼
54 12⅛
53 12⅛
52 11⅞
51 12
50 12
49 12⅛
We have made this graph using
3 wheel lever fence type locks &
carrying all wheels to the right
2½ number at a time & each time
returning to contact point for reading.

GRAPH NO. 1

1. Turn dial 4 times right carrying all wheels to "0". Turn dial left to contact point. (Note) Grasp dial lightly as you turn to contact point.

Take reading on dial and record on graph. (See sample graph)

Turn dial right moving all wheels to 97½.

Turn dial left to contact point, take reading and record on graph.

Turn dial right moving all wheels to 95,

Turn dial left to contact point, take reading and record on graph.

Turn dial right moving all wheels to 87½,

Turn dial left to contact point, take reading and record on graph.

Before taking reading each time at contact point, oscillate dial right and left over drive-cam opening to float or work fence down as far as possible. This will give you a closer reading.

Follow above procedure every 2½ numbers moving all wheels completely around the dial taking readings and making recordings on the graph.

CAUTION: As you move the wheels to the right and pass the contact point you must remember that you only have a short distance to move left to contact point to take reading rather than rotating clear around dial.

EXAMPLE: Our contact point is approximately 12 so as we pass 12 and go to 10 with all wheels we only turn back left 2 points to our contact point to obtain reading.

When finished dialing, examine graph for—

1. *Sharp drops and rises.*

2. *Gradual drops or rises.*

Underscore graph at lowest point. This is the low area of the wheel pack. (Note graph showing low point at 52½.)

We must now determine exact low point of this area by rotating dial 4 times right, stopping at 56.

Turn dial left to contact point and record reading.

Turn dial right moving all wheels from 56 to 55.

Turn dial left to contact point and record reading. Continue every number to 49, each time moving wheels only one number at a time, and record reading. By checking recordings, we find 52 gives the best reading or indication, so we assume 52 is one of the combination settings.

The use of graphs in learning manipulation is most important, and we advise making a graph on every lock you manipulate until you become proficient at it. A graph will give you an overall picture of low areas of the wheel pack and in some cases will indicate two numbers of the combination setting. Always study your graphs thoroughly, not only sharp declines, but also gradual declines over several numbers because occasionally, you will not get a sharp decline, indicating a wheel opening or gating, therefore you will have to set number one and two wheels in this gradual low area, and try to get a good or better reading, or indication on number three wheel.

(Example) Assuming the gradual low area is between 37 and 52.

Turn dial right four times, stopping at the center of the low area (approximately 43).

Turn dial left one complete revolution, picking up number three wheel at 43 and stop at 45.

Turn dial right to contact point, take reading and record on graph.

Turn dial left to 45, picking up number three wheel and stop at 47½.

Turn dial right to contact point, take reading and record on graph. Continue moving number three wheel every 2½ numbers clear around the dial.

Determine which wheel or tumbler is giving the lowest reading or best indication. By the process of elimination, find which wheel is giving the low or good indication.

Turn dial right four times, stopping at 52.

Turn dial left. (NOTE: When we turn the dial left we are moving the dial and drive cam only. No tumblers until we come to 52), and at 52 we pick up number three tumbler which is closest to the drive cam and stop at 62.

Turn dial right to contact point and take reading. (Number one and two tumblers are on 52, and number three tumbler is on 62.) If good reading or indication is lost, chances are number three tumbler is the one giving the good indication. If you still have a good indication, rotate dial left to 62, picking up number three wheel or tumbler, continuing left and pick up number two wheel at 52 and stop at 62. Rotate dial right to contact point and take a reading. If good reading or indication is lost, chances are number two tumbler is the one giving a good reading or indication. If you still have a good indication, number one wheel being the only wheel left, is the one giving the good indication.

What we are actually doing is throwing one wheel at a time off the number that is giving the good indication, starting with the wheel which is nearest to the drive cam, or number three wheel in a three wheel lock and number four wheel in a four wheel lock. (In this case, it is a three wheel lock.) Assuming that number three wheel was the one giving the good indication, we know that the third number of our combination is 52.

Determining the low area or drop in point of tumblers number one or two. (Prepare a graph for readings on number one and two wheels.)

NOTE: At this point, your indications or readings will only increase a very small amount, or approximately ⅛th of a number on the dial. Whereas on number three wheel the increase was approximately ¼th of a number. (NOTE FIRST GRAPH.)

Turn dial right four times, stopping at 97½.

Turn left one complete revolution of the dial and at 97½ you pick up number three wheel and continue left stopping at 52.

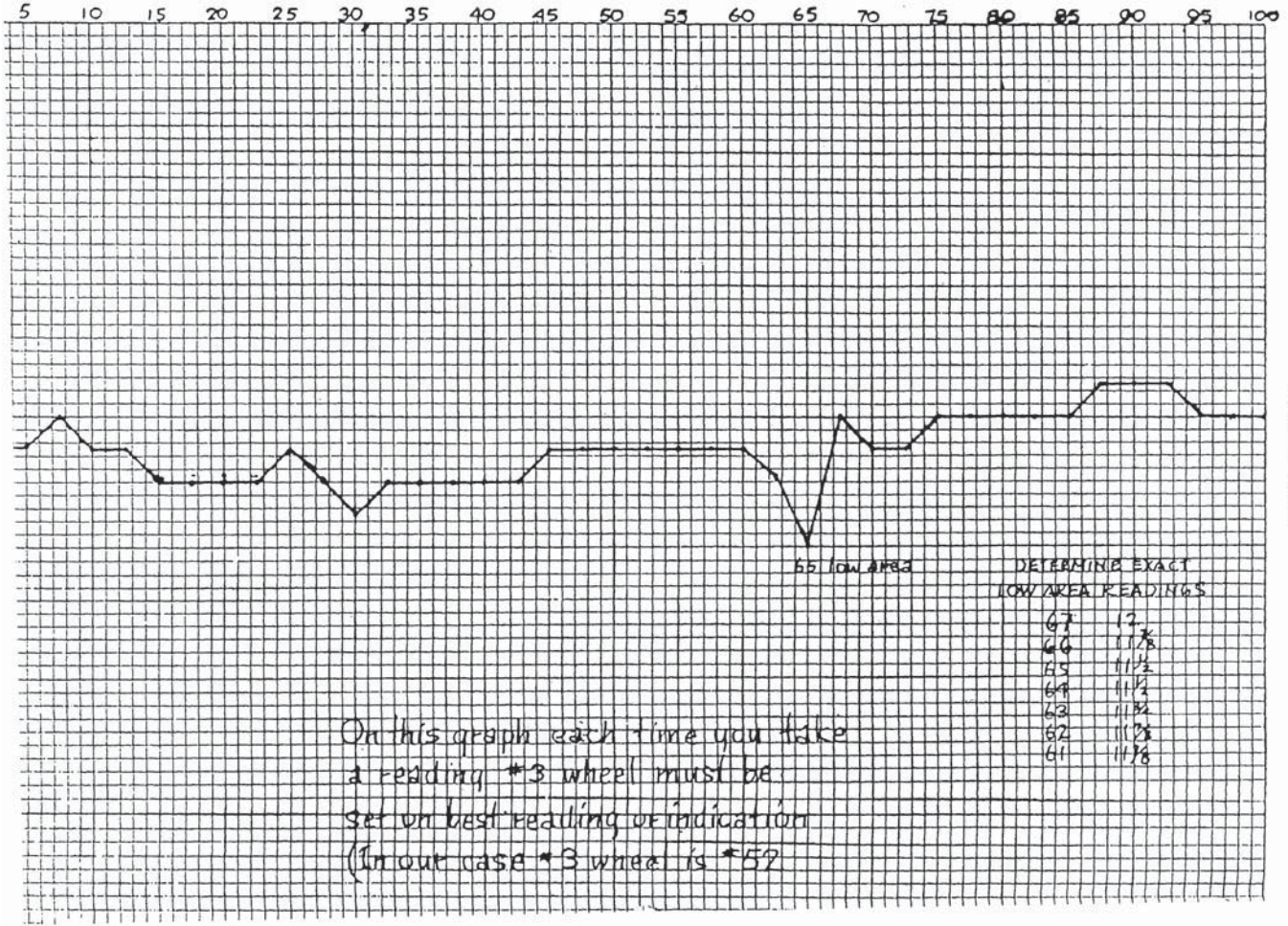
Turn dial right to contact point, and record reading on graph.

Turn dial right, picking up number three wheel at 52, continue right picking up number two and one wheel at 97½ and stopping at 95.

Turn dial left, one complete revolution, picking up number three wheel at 95, continue left stopping at 52.

Turn dial right to contact point, take reading and record on graph. Continue with the above procedure every 2½ numbers, clear around the dial, each time placing number three wheel on 52 and recording your readings on your graph.

Determine exact low area of wheels number one and two. (Observe graph number two.) We find that the low area according to our graph is about 65.


5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100
65 low area
DETERMINE EXACT
LOW AREA READINGS
67 12
66 11 7/8
65 11 1/2
64 11 1/2
63 11 1/2
62 11 1/8
61 11 1/8
On this graph each time you take
a reading #3 wheel must be
set on best reading or indication
(In our case #3 wheel is #52

GRAPH NO. 2

Turn dial right four times, stopping at 68.

Turn left one complete revolution, picking up number three tumbler or wheel at 68, and stopping at 52.

Turn dial right to contact point, take reading and record.

Turn dial right and pick up number three wheel at 52, continue right picking up number one and two wheels at 68 and stop at 67.

Turn left one complete revolution, picking up number three wheel at 67, continue left stopping at 52.

Turn right to contact point, take a reading and record. Continue moving number one and two wheels to the right, one number at a time through 62, each time placing number three wheel on 52 and returning to your contact point for a reading. From our graph we find that the exact low area of number one and two wheels is 64, and with number three wheel on 52, we got the best indication or reading.

NOTE: You will notice from graph number one, when we were carrying all three wheels to the right and taking indications, number 52 read 11⅞ on the dial. Now on graph number two with number one and two wheels on 64 and number three wheel on 52, our best reading was 11½.

How to determine which wheel is giving a good indication at 64. Number one or number two wheel?

Turn dial right four times to 64. Turn dial left, one complete revolution picking up number three wheel at 64, continue left one more revolution, picking up number two wheel at 64 and stopping at 74.

Turn dial right one complete revolution picking up number three wheel at 74 and stopping at 52.

Turn left to contact point, and take a reading. If good indication has been lost, chances are that number two wheel, which is set on 64, was the one giving the good indication or reading. If good indication remains, then number one wheel was the wheel giving a good indication. In our case, the good indication was lost, showing that 64 is number two wheel, or the second number of the combination.

We now know the combination setting of number two wheel is 64, and number three wheel is 52.

By the process of elimination we must now find the combination setting of wheel number one.

Turn right four times stopping at 97½.

Turn left three times to 64.

Turn right two times to 52. Left to drive cam opening, and oscillate dial back and forth between contact points.

NOTE: By oscillating dial rapidly between contact points after trying each combination setting, you will notice by sound and feel as you approach the combination setting of number one wheel, also if by chance you are a number or two off of the true combination setting, one way or another, we can work the fence into the wheel gatings by this oscillation.

Turn right four times stopping at 95.

Turn left three times to 64. Turn right two times to 52.

Turn left to drive cam opening, and oscillate dial back and forth between contact points. Continue moving number one wheel every two and one-half numbers, each time placing number two wheel on 64 and number three wheel on 52, until lock is open.

In most cases, number three wheel usually indicates first.

We are now going to explain what to do if number two wheel indicates first.

Having determined your exact low point from your graph, and proved it to be number two wheel that is giving the good indication, it is advisable to try and determine the combination setting of number three wheel, because it is the easiest to move.

EXAMPLE: We find that a good indication was at 36 and we proved it to be number two wheel.

Turn dial right four times stopping at 36.

Turn dial left one complete revolution, and at 36 we pick up number three wheel (leaving number one and two wheels at 36), and stop at 37½.

Turn dial right to contact point, take a reading, and record on graph.

Turn dial left, picking up number three wheel at 37½ and stop at 40.

Turn dial right to contact point, take a reading and record on graph. Continue moving number three wheel every 2½ numbers. completely around the dial, each time taking a reading and recording on your graph.

We have done this without moving or disturbing number one and number two wheels which we have left on 36.

NOTE: As you rotate number three wheel to left every 2½ numbers, and pass your point of contact, you will only have to turn dial right a very short distance to take a reading.

EXAMPLE: Contact point is 3¼. With number one and two wheels on 36, and moving number three wheel left every 2½ numbers, pass contact point, stop at 5.

Turn dial right only 1¾ numbers to contact point, which is 3¼, take a reading and record.

Turn dial left and at 5 pick up number three wheel and move to 7½.

Turn dial right only 4¼ numbers to contact point, take a reading, and record. Continue moving number three wheel left until you come to 35.

Check your graph for lowest area and determine exact low point of number three wheel by moving number three wheel over this area one number at a time. Suppose you found number three wheel to be set on 82. You now have the combination setting of number two and three wheels. Follow the same procedure as before by moving number one wheel 2½ numbers at a time and each time set number two wheel on 36 and number three wheel on 82, until lock is open.

EXAMPLE: Right four times to 97½. Left three times to 36. Right two times to 82. Left to contact point or drive cam opening, and oscillate dial.

We will now explain what to do if number one wheel indicates first. In most cases where number one wheel indicates first, number two wheel will indicate next.

Having determined your exact low point from your graph, and proved it to be number one wheel that is giving the good indication. (Example: We find that the best reading was at 27 on number one wheel.)

Turn dial right four times stopping at 27.

Turn dial left two complete revolutions, picking up number three wheel on the first revolution at 27, and number two wheel on the second revolution at 27, and moving them both to 30.

Turn dial right to contact point, take a reading and record on graph.

Turn dial left, picking up number three and number two wheels at 30 and stopping at 32½.

Turn dial right to contact point, take a reading and record on graph. Continue moving number three and two wheels to left every 2½ numbers completely around the dial to 25. Each time taking a reading and recording on graph. (We have done this without moving number one tumbler which we left set at 27.)

Determine the exact low point of number two wheel (assuming it to be at 47), and use the process of elimination on number three wheel. This is done very simply, as number three wheel is very easy to move without disturbing the others.

Turn dial right four times to 27.

Turn dial left three times to 47.

Turn dial right one revolution, picking up number three wheel at 47 and stopping at 45.

Turn dial left to contact point and oscillate back and forth over drive cam opening.

Turn dial right picking up number three wheel at 45 and move to 42½.

Turn dial left to contact point and oscillate back and forth over drive cam opening. Continue moving number three wheel right every 2½ numbers until lock is open. (We have moved number three wheel around the dial without having moved number one or two wheels, which we left on 27 and 47 respectively.

OTHER TYPE LOCKS

We have explained step by step the procedure to follow in manipulating the lever type fence lock, and will now explain the methods used in the rotary fence gear driven, rotary fence spring loaded, straight in tail piece, bottom drop, and off-set gear driven type locks. In all the above mentioned locks the principle is the same, except for the methods used in obtaining readings or indications.

1. *Rotary fence gear driven type locks.*

The only difference between this type lock and the lever fence type is that you can only get a reading on the dial by rotating to the left, or counter clockwise. The reason for this is as you turn dial to the right, the friction between the gear and the fence moves the fence away from the drive cam and wheels. Where by rotating the dial left, the fence moves toward or against the drive cam and wheels, allowing you to take a reading at the drive cam opening.

Occasionally in this type lock, due to variances in manufacturing, the drive cam is smaller than the wheels or tumblers allowing the fence to ride on the tumblers, and by turning the dial to the left slowly and carefully, you can feel and sometimes hear the gatings in the wheels as they rotate by the fence.

2. *Rotary fence, spring loaded type locks.*

This lock is manipulated in the same manner as the lever fence type lock.

3. *Straight-in-tail-piece type lock.*

The difference in this type lock is that readings must be taken from the handle of the safe instead of the dial.

The first step in manipulating this type is to make a pointer twelve to eighteen inches long and clamp it to the handle of the safe. At the tip of this pointer attach a sheet of paper to the door of the safe with scotch tape and mark graduations on it every 1/16 inch. This is where you will take your readings.

The second step is to determine the drive cam opening. This type lock usually has false gatings all around the drive cam, but the true gating is usually narrower and by rotating the dial with pressure on the handle, you can determine which is the true gating or drive cam opening by the amount of play in the dial, when held by the handle tailpiece. Having determined the drive cam opening, follow the same procedure as on the lever fence type lock with the exception that you must take your readings from the pointer attached to the handle.

4. *Bottom drop type lock.*

Type A: Gravity type fence.

This type lock is manipulated in the same manner as the lever fence type lock.

Type B: Fence actuated by handle pressure.

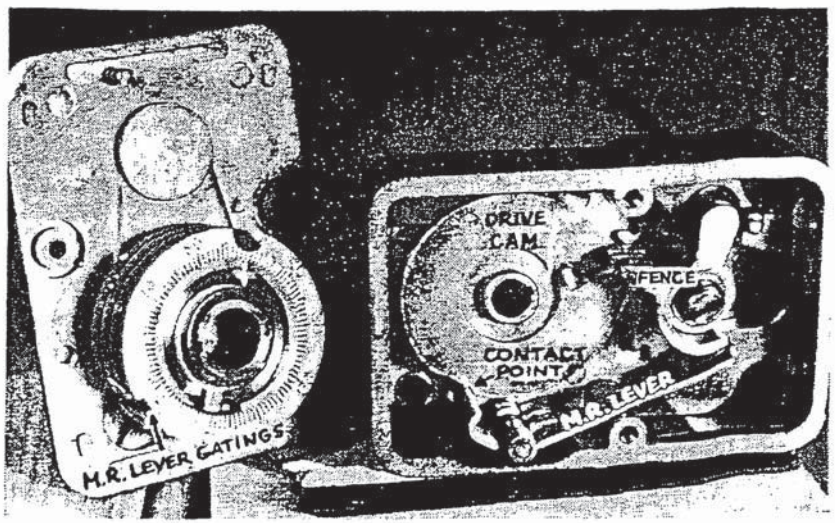
This type lock is manipulated in the same manner as above mentioned lock except the handle must be turned to raise the fence so it will contact the drive cam opening and wheels in order for you to take readings or indications.

5. *Off-set gear driven type locks.*

Manipulation is accomplished in the same manner as the direct drive type locks, but are more difficult due to the slack in the gears, and requires more practice to become proficient.

Manipulation Resistant Type Locks

As you may know, there have been so-called pick-proof key locks made from time to time, and as yet none of them are impossible to pick, they only slow you up a little. The same is true of combination locks. The manipulation resistant locks do just that, to the extent that it is impractical to attempt manipulation in most cases. However, we will attempt to show you how it can be done.



ROTARY FENCE GEAR DRIVEN TYPE.

Rotary Fence Gear Driven Type

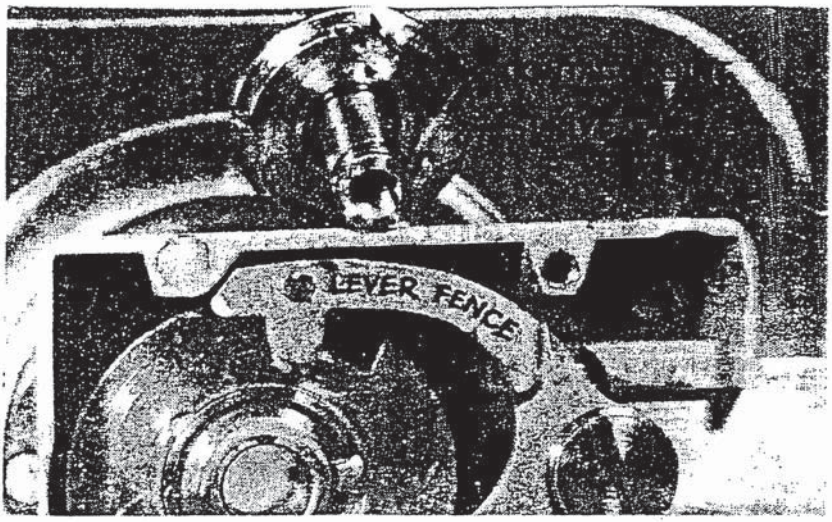
This lock is the same as the old type except for an additional lever which has been added to hold the fence away from the drive cam and tumblers until the proper combination has been run. Then it drops into a narrow gating in all of the tumblers, and allows the fence to contact the drive cam and open the lock. This lever we will refer to as the manipulation resistant lever. Instead of taking readings at the regular drive cam opening and fence, we will get all of our indications from this lever and the small gatings in the tumblers and the slight depression in the drive cam which this lever drops into when the lock is opened.

(SEE ILLUSTRATION PAGE 32)

The point of contact will be approximately 2 or 3 on the dial where this manipulation resistant lever contacts the edge of the depression on the drive cam as you rotate the dial to the left. This lock also has four tumblers, but as you know, lots of times are only set on three numbers.

As an aid in obtaining readings or indications on this type lock, it is usually necessary to mount a good magnifying glass or reading glass over the dial in order to be able to see your indications, as they are so slight. Also a large pointer, twelve to eighteen inches long, may be attached to the *dial* as we did on the safe handle with the straight-tail-piece. This will increase the slight variations to an extent that you will be readily able to read your indications. Other than this the lock is manipulated in the same manner as the regular rotary fence gear driven lock. You will be seeing this lock more and more, as it is being used quite extensively on new equipment.

Lever Fence Type



This lock is similar in outward appearance to the regular type lock of the same manufacture. In working the combination of this type lock, after dialing the combination setting, turn the dial to 100 and push in, allowing the lever to drop into the drive cam opening and rotate the dial to the right, retracting the bolt. The dial is spring loaded and can only be pushed in at 100.

In order to manipulate this lock, you will have to secure a machinist's dial indicator and mount it on the front of the safe with the tip of the indicator touching the outermost point of the dial knob.

The manipulation procedure is the same as a regular lever fence lock except each time a reading is obtained the dial is set on 100, and pushed all the way in, allowing the lever and fence to drop down on the wheels. You then slowly let the dial come out until the lever contacts the beveled edge of the drive cam and take a reading on the dial indicator. The lesser reading on the dial indicator will possibly be a combination setting. Again we say, "It can be done," but it is highly impractical, due to the time involved.

Conclusion

In conclusion, we might add that success is not accomplished overnight, nor will the art of manipulation be mastered without diligent study of this book and all type safe locks. It is most important in learning manipulation that you take the time to develop your sense of touch in locating your points of contact and training your eyes to notice any slight change in the contact point, including a deviation of 1/8 of a number.